CCS Technical Documentation
RH-42 Series Transceivers

Troubleshooting Instructions

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Transceiver Troubleshooting

First, carry out a thorough visual check of the module. Make sure that:

- there is no mechanical damage
- the solder joints are OK

Note: Before changing anything, ALL SUPPLY VOLTAGES AND THE SYSTEM CLOCK / SLEEP CLOCK should be checked.

Baseband Troubleshooting

General testing

The phone has three different modes for testing and/or repairing the phone. The modes can be selected with suitable resistors connected to BSI- and BTEMP- lines as illustrated in the following table:

Mode	BSI-resistor	BTEMP resistor	Remarks
Local mode	0 - 1k	0 - 1k	
Test mode	>1k	0 - 1k	
Normal mode	68k	47k	Recommended for baseband testing. Same as local mode, but making a phone call is possible.

If the corresponding resistors are connected, the MCU software automatically enters into the local or test mode when the supply voltage is connected to the phone.

The power can be switched on by:

1 Pressing the power key.

2 Connecting the local/test mode resistors to the bsi/btemp lines and connecting the battery voltage to the phone.

3 Connecting a charger.

4 Phone's internal functions (Real time clock alarm)

In the local and test mode, the baseband can be controlled through MBUS or FBUS (FBUS is recommended) connections using Phoenix service software.

Troubleshooting

Note: Most of the baseband repair actions require removing the baseband shield. The shield must not be removed unless separately authorized by the program.

Note: The phone's ESN has to re-written to the UEM, if the UEM is replaced. This can be done only in Central Service.

The BB troubleshooting instructions consist of the following topics:

1 Power up

2 Flash programming

3 Audio

- Earpiece
- Microphone

4 Charging

5 Accessory detection

6 Sleep clock

7 User interface

- Display
- Lights
- Buzzer
- Keyboard

Power up faults

Power up sequence

1 The UEM acts as a HW master during start up

- Vbatt limits: 2.1V for internal state machine, 3V triggering whole startup
- Regulator sequencing
- HW "core" regulators "on": Vio, Vcore, VR3, Vflash1

These regulators supply the processors, memory, chip interfaces and clock source in RF

- Reset releasing delay
- Supply voltages stabilize to their UEM HW default values
- RFCLK grows to full swing
- The core is ready to run but waiting for the PURX release

- Reset releasing
  - The UPP releases the SLEEPX up to the "non sleep" -state to prevent the UEM switching the regulators "OFF"

2 MCU starts running the Bootsrap Code

- Written in stone/ UPP internal ROM
- The program checks if there is any reason for the FDL mode (Flash Down Load)
- If there is an executable code in FLASH and there is no reason for FDL, the MCU starts running the MCU program from FLASH.

3 MCU runs the FLASH MCU code

- The phone initialization, user interfaces, internal blocks, etc.
- Core regulator voltage setting for required DSP speed
- Initializes the DSP and concerning HW
- Releases DSP reset -> DSP starts running

Note: In the following figure, the RF_Clk frequency appears to be lower than 19.44 MHz because of a too low oscilloscope sampling frequency (2kS/s).

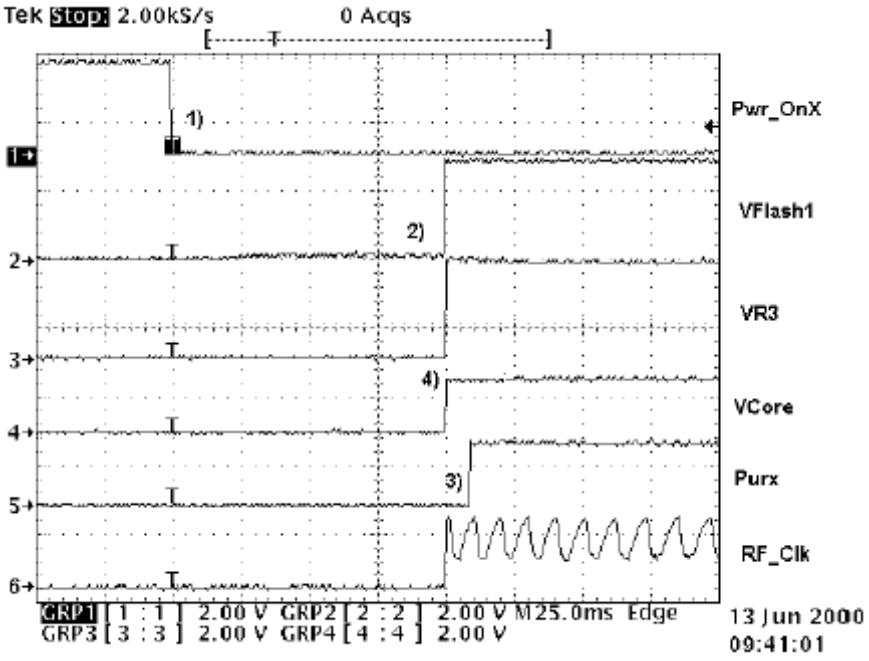


Figure 1: Power up sequence

1 Power key pressed

- After 20ms UEM enters RESET MODE if VBAT>Vmstr+
- VFLASH1, Vana, Vcore, Vio and VR3 goes high.
- VCTCXO enabled by VR3 -> RFClk 19.44 MHz running.

2 Purx released

- Purx released by UEM, UEMINT goes high for 100 ms, SleepX goes high and UEM starts feeding SleepClk (32 KHz) to UPP.

Note: The sleepclock starts running in the crystal circuitry (B200) immediately when the battery voltage is supplied.

3 Software running

- Default value for Vcore is 1.5 volts when the software is running.
- Cbus (1.08MHz) clock starts running.

Phone does not start up normally or does not stay on

Note: In case of power up faults, it is not possible to force the phone on by disabling the watchdog. Instead, measurements should be taken immediately when the power key is pressed or when the battery voltage is connected to the phone (local/test mode).

The easiest way to check if the software is running when the phone takes an abnormal amount of current is to measure the *cbusclk* and *Vcore*.

The Dbus clock (programmable 9.72 MHz) is not automatically visible in the test and local modes.

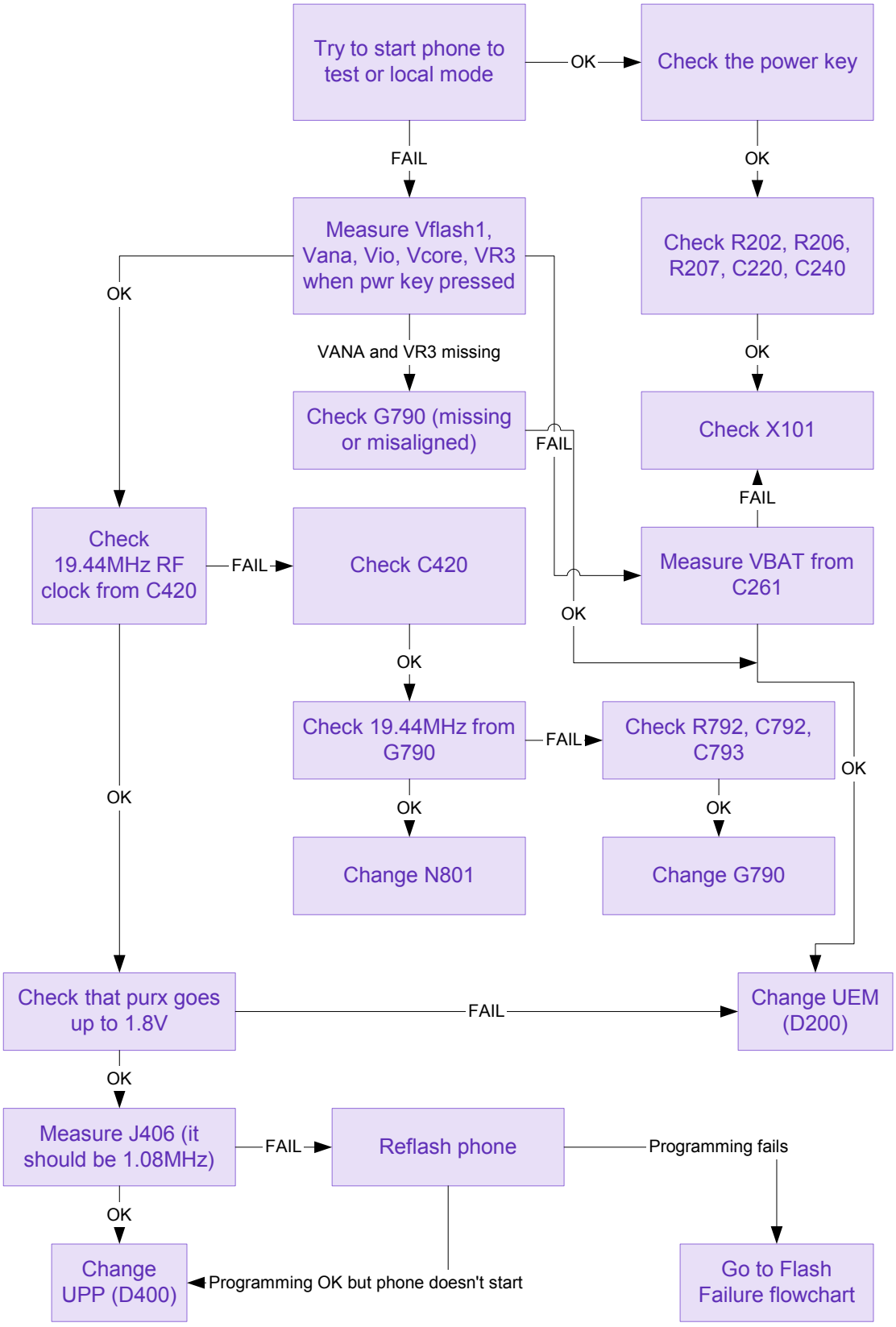


Figure 2: Fault tree, phone does not power up

Flash Programming does not work

Flash programming procedure

1 The phone communicates with the prommer via the production test pattern, using the following signals:

- FBUSTX(serial data **to** phone)
- FBUSRX(serial data **from** phone)
- MBUS(serial clock for FBUSRX)
- VPP(External flashing voltage for speed up flashing)

The BSI line is also used when initializing flashing (battery connector).

2 When the phone is powered (VBAT>3V), the MBUS and FBUSTX lines are pulled up internally by the phone.

3 The prommer sends a command to the UEM, using FBUSRX, to enter the Flash-mode. During the sending of this command, the prommer keeps the BSI line high and MBUS is used as a serial clock.

4 When the Flash-mode command is acknowledged, **UEM** enters the Flash-mode and releases reset (PURX) to MCU.

5 After reset is released, UPP checks if there is a request for the Bootstrap code (that resides in the UPP ROM).

6 The request for Bootstrap is the MBUS pulled down by the prommer (if the bootstrap is not requested, the bootstrap code jumps to FLASH SW).

7 If the Bootstrap code is requested, **UPP** enters the Flash-mode and sets FbusTX to '0' as an acknowledgement to the prommer. This is an indication that UPP can run, at least, the fixed Bootstrap code – although it is not able to run the FLASH code. UPP then sends an UPP-ID to the prommer via the FBUSTX line.

8 After the prommer has received the UPP-ID, it sends a corresponding Secondary Boot Code to the phone via FBUSRX. The Secondary Boot Code, when run in UPP, requests UPP to send information to the prommer about the flash type and other HW-related parameters about the device to be flashed.

9 Prommer then sends the Algorithm Code corresponding to the HW parameters, and this algorithm, when run in UPP, takes over handling the MCUSW transfer to Flash.

10 12 volts can be supplied to Vpp (by the prommer) to speed up flashing.

11 The FLASH Program includes a package of MCU and DSP software and all default parameters for the phone. The tuning values will be added/rewritten during the Flash/Alignment phase.

Flash programming error codes

The various error codes can be seen from the FPS-8 Flash in Phoenix.

The underlined text in the table below means that the item under consideration is being used for the first time in the flashing sequence.

Error	Description	Not working properly
C101	"The Phone does not set FbusTx line high after the startup."	Vbatt Vflash1 Vcore VIO BSI and FbusRX from prommer to UEM. FbusTx from UPP->UEM->Prommer(SA0)
C102	"The Phone does not set FbusTx line low after the line has been high. The Prommer generates this error also when the Phone is not connected to the Prommer."	PURX(also to Taco) VR3 Rfclock(VCTCXO->Taco->UPP) Mbus from Prommer->UEM->UPP(MbusRx)(SA1) FbusTx from UPP->UEM->Prommer(SA1)
C103	"Boot serial line fail."	Mbus from Prommer->UEM->UPP(MbusRx)(SA0) FbusRx from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
C104	"MCU ID message sending failed in the Phone."	FbusTx from UPP->UEM->Prommer
C105	"The Phone has not received Secondary boot codes length bytes correctly."	Mbus from Prommer->UEM->UPP(MbusRx) FbusRx from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
C106	"The Phone has not received Secondary code bytes correctly."	Mbus from Prommer->UEM->UPP(MbusRx) FbusRx from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
C107	"The Phone MCU can not start Secondary code correctly."	UPP
A204	"The flash manufacturer and device IDs in the existing Algorithm files do not match with the IDs received from the target phone."	Flash Signals between UPP-Flash
A387	"The MCU ID in the MCUSW."	UPP
C601	"The prommer has detected that Vpp voltage level has dropped below the limit"	Vpp from prommer - >Flash

C383 C583 C683	"The Prommer has not received Phone acknowledge to the message." (C383-during algorithm download to target phone) (C583-during erasing) (C683-during programming)	Flash UPP Signals between UPP-Flash
C384 C584 C684	"The Phone has generated NAK signal during data block transfer." (C384-during algorithm download to target phone) (C584-during erasing) (C684-during programming)	Flash UPP Signals between UPP-Flash
C585 C685	Data block handling timeout" (C585-during erasing) (C685-during programming)	Flash UPP Signals between UPP-Flash
C586 C686	"The status response from the Phone informs about fail." (C586-during erasing) (C686-during programming)	Flash

Charging

Note: The charging voltage and current can be checked by connecting the phone to the service software and reading the ad- converter values of the vchar and ichar.

If charging fails when the LCH-9 is used, and works with ACP-7 and ACP-8, check that the charge control pin of the system connector is connected to the ground.

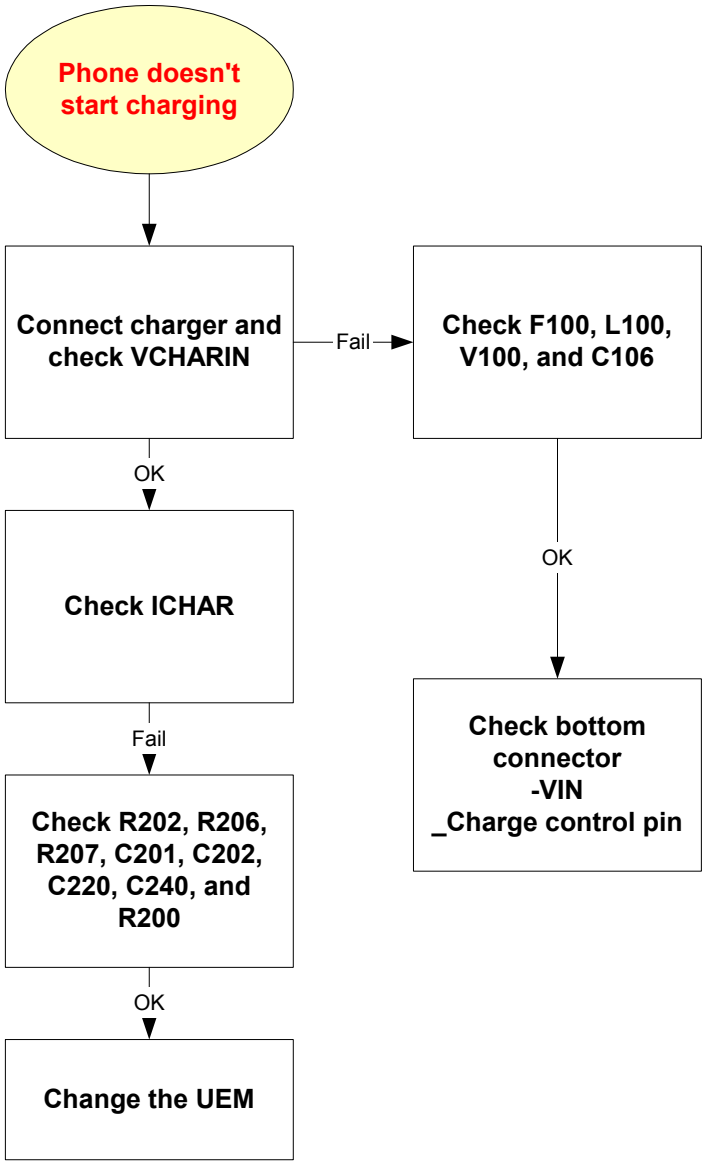


Figure 3: Fault tree, charging

Audio failures

In case of audio failures, there are three possibilities to check the audio lines.

1 Make a phone call against tester and check audios.

2 In case the earpiece/XMIC fails: Feed a 1 Khz signal to the XMIC line and measure the signal from the earpiece line. The Audio test box (JBA-8) is needed. The Audio loop (*Audio test/Ext In Hp Out*) must be switched on by the Phoenix service software. This loop will connect audios only through the UEM. In this case, the UPP is not used.

In case the internal microphone/XEAR fails: Feed the tone to the microphone and measure the signal from the XEAR line. The Audio test box (JBA-8) is needed. The Audio loop

(*Audio test/Hp In Ext Out*) must be switched on by the Phoenix service software. This loop will connect audios only through the UEM. In this case, the UPP is not used.

3 Run the audio-loop self-test with Phoenix (*BB Self Tests/ ST_EAR_DATA_LOOP_TEST*). This loop will test the ear-data/mic-data lines between the UPP and the UEM.

Earpiece or external microphone line does not work

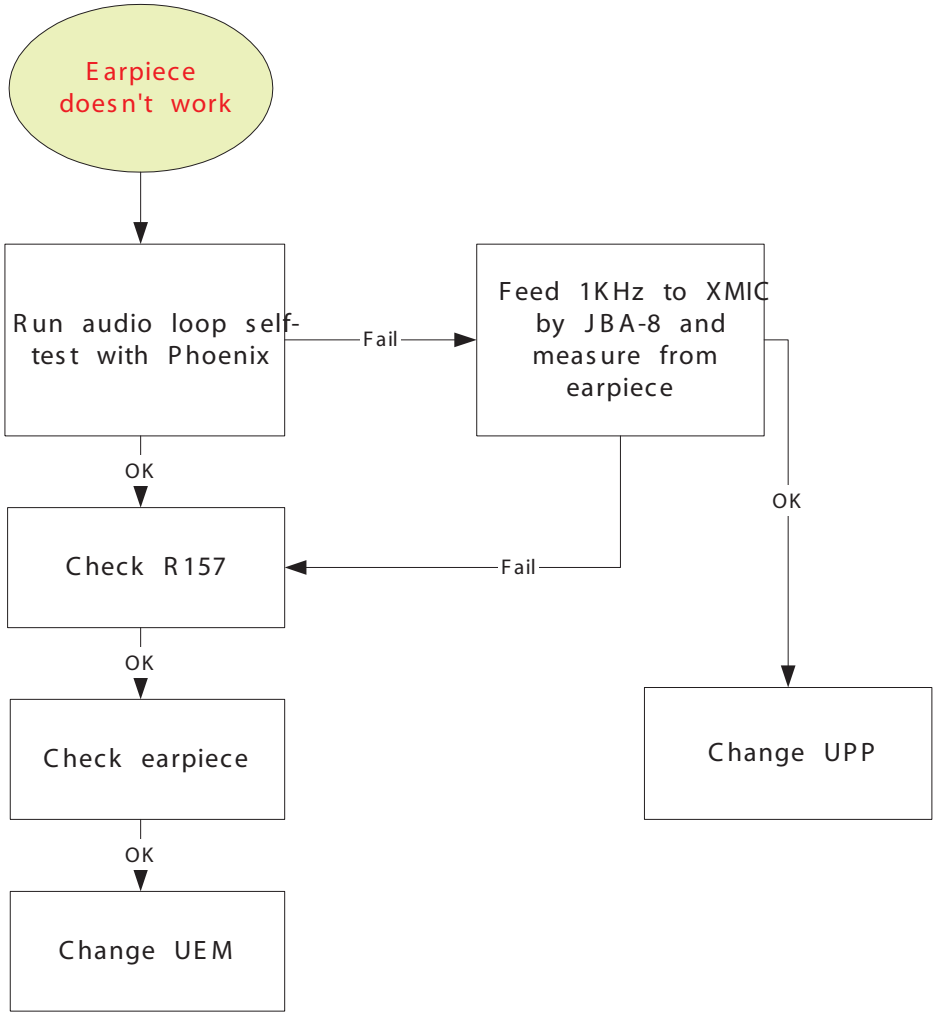


Figure 4: Fault tree, earpiece failure

Microphone or XEAR line does not work

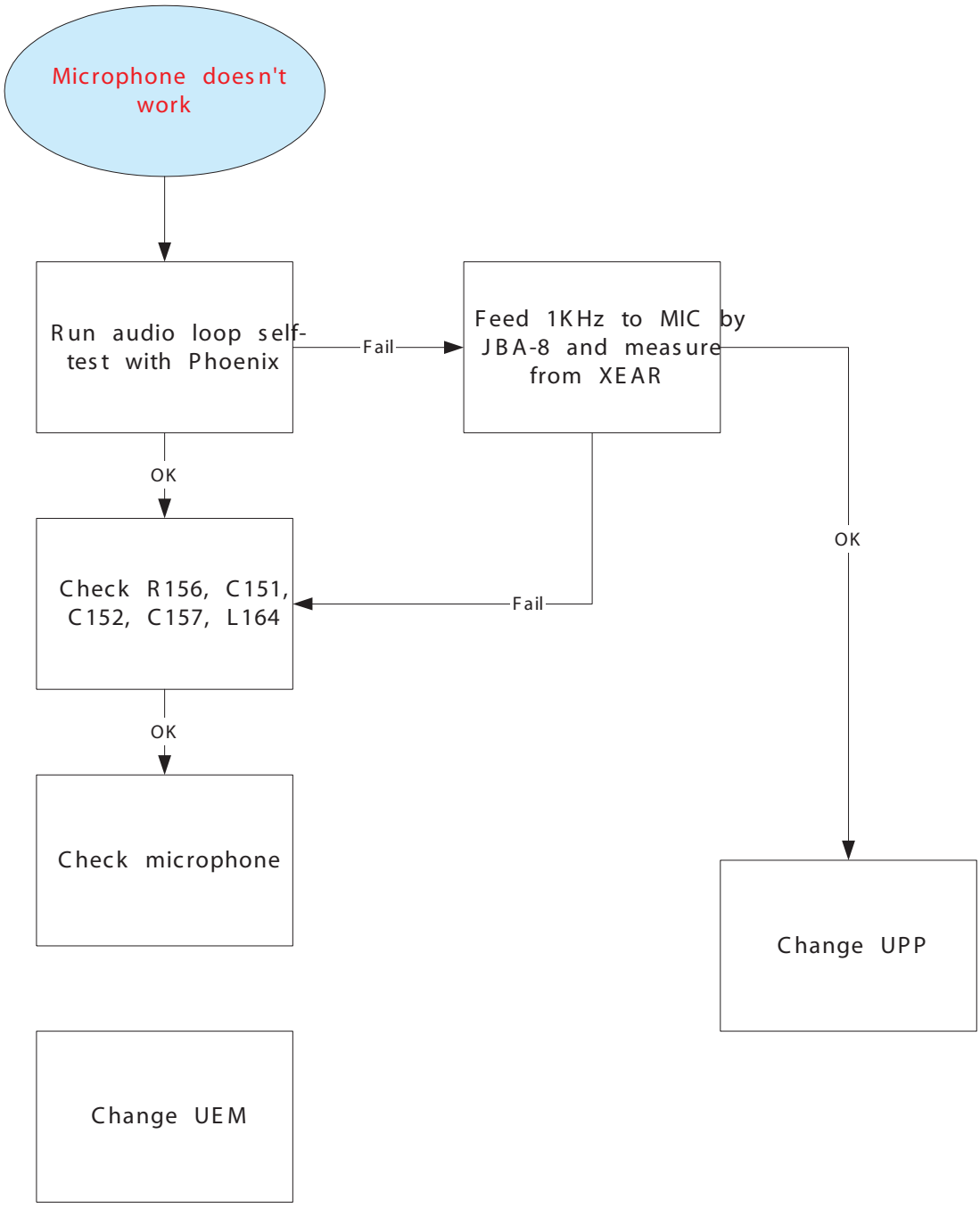


Figure 5: Fault tree, microphone failure

Accessory detection

1 Start the phone in the normal mode when checking for accessory detection.

2 The Ad- converter value of the hookint-line can be checked with the Xmic-switch on an MJS-18 test jig. Changes normally from high to low when no accessory is connected.

3 When the headset (HDC-5) is connected, the hookint- value should be between 600 and 800.

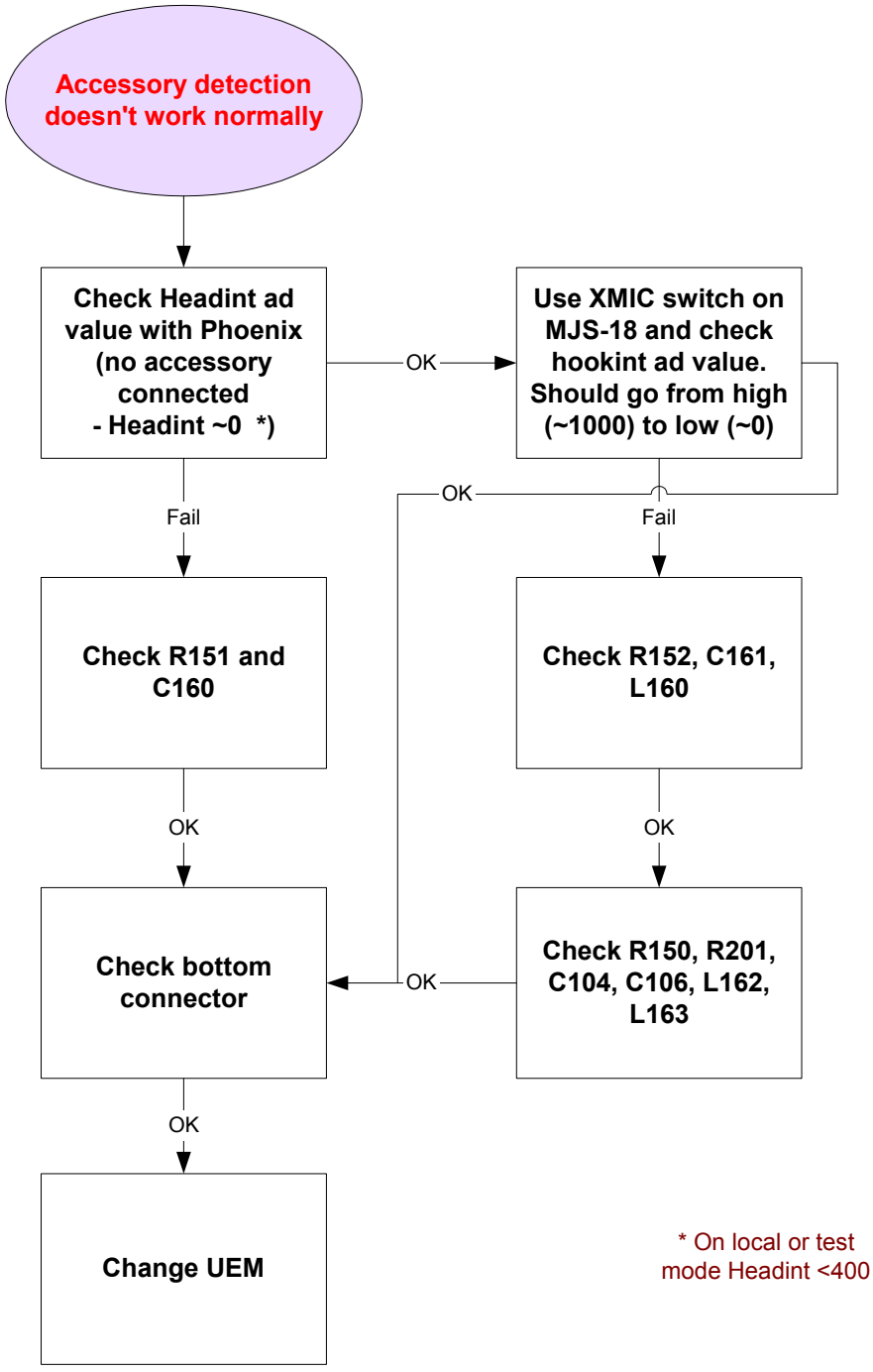

Accessory detection doesn't work normally
Check Headint ad value with Phoenix (no accessory connected - Headint ~0 *)
OK
Use XMIC switch on MJS-18 and check hookint ad value. Should go from high (~1000) to low (~0)
Fail
OK
Fail
Check R151 and C160
Check R152, C161, L160
OK
OK
Check bottom connector
OK
Check R150, R201, C104, C106, L162, L163
OK
Change UEM
* On local or test mode Headint <400

Figure 6: Fault tree, accessory detection

Sleep Clock

Missing/nonfunctional sleep clock causes

- Entering sleep mode fails (higher current consumption -> shorter standby time).
- Baseband self tests cannot be run.
- Phone clock (on display) does not function properly.

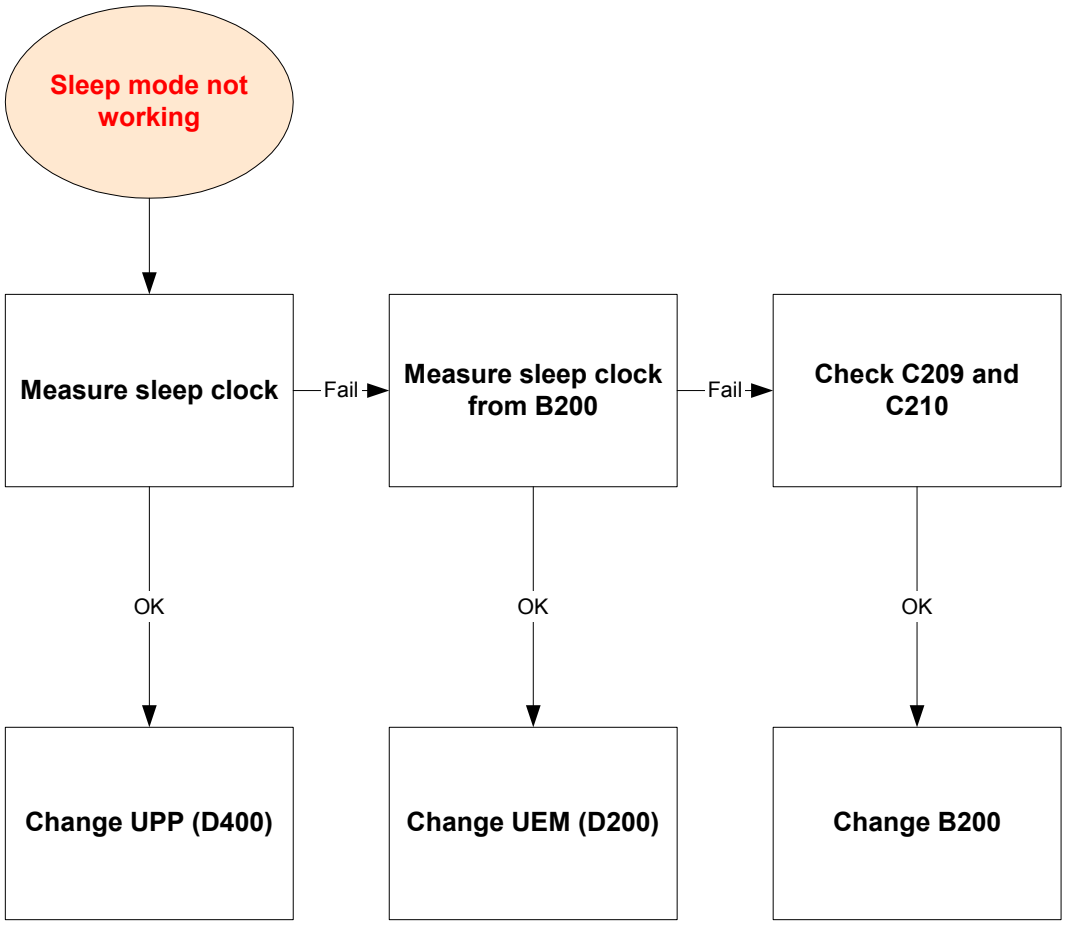


Figure 7: Fault tree, sleep clock

Display/Keyboard lights do not work

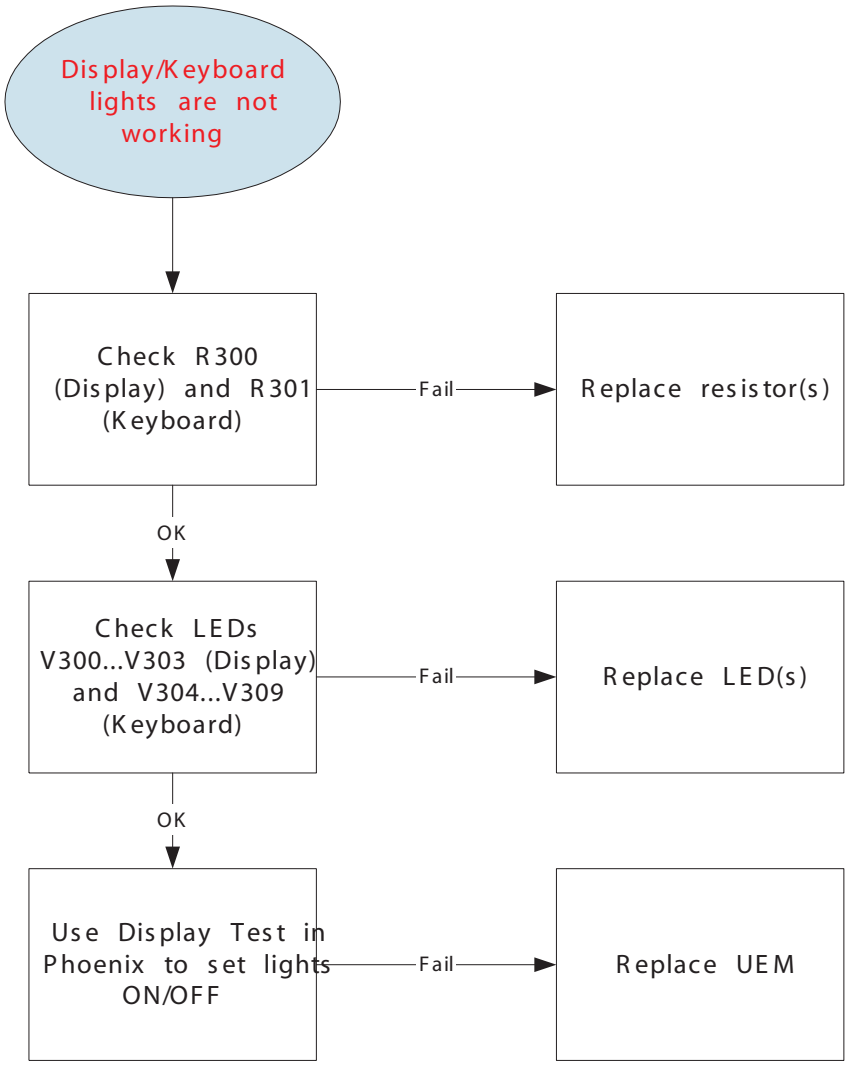


Figure 8: Fault tree, Display/Keyboard lights

Display does not work

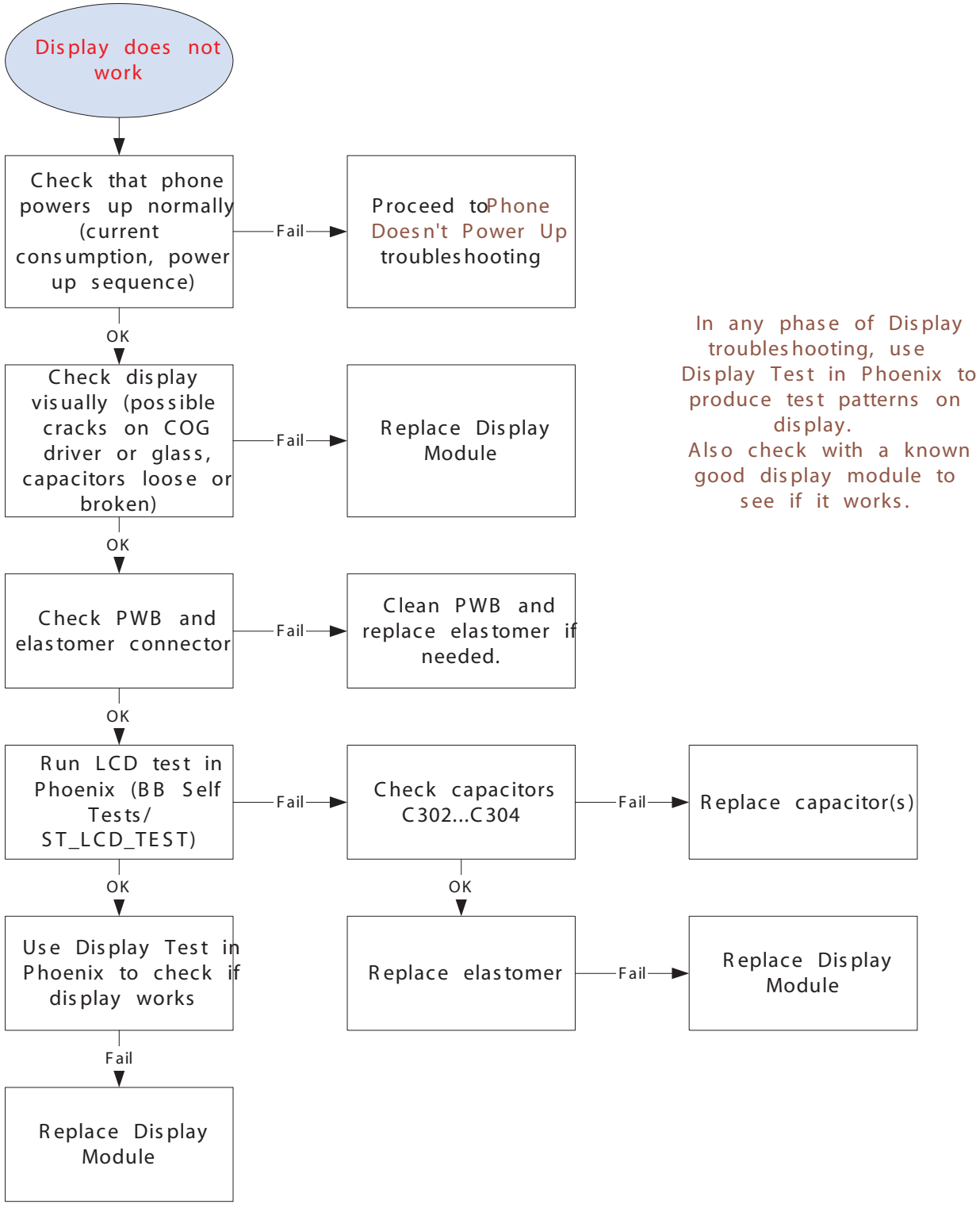

Display does not work
Check that phone powers up normally (current consumption, power up sequence)
Fail
Proceed to Phone Doesn't Power Up troubleshooting
OK
Check display visually (possible cracks on COG driver or glass, capacitors loose or broken)
Fail
Replace Display Module
OK
Check PWB and elastomer connector
Fail
Clean PWB and replace elastomer if needed.
OK
Run LCD test in Phoenix (BB Self Tests/ ST_LCD_TEST)
Fail
Check capacitors C302...C304
Fail
Replace capacitor(s)
OK
OK
Use Display Test in Phoenix to check if display works
Replace elastomer
Fail
Replace Display Module
Fail
Replace Display Module
In any phase of Display troubleshooting, use Display Test in Phoenix to produce test patterns on display.
Also check with a known good display module to see if it works.

Figure 9: Fault tree, Display does not work

Buzzer does not work

Check spring connectors and C306.

- *No sound:* Try using a known good buzzer instead. If there is still no sound, change the UEM (D200)

- *Weak sound:* Use the Audio test in Phoenix to set the buzzer parameters (frequency, strength). If it does not affect the sound level, change the buzzer.

Keyboard does not work

Check that there is no dirt between the dome sheet and the PWB. Check EMI/ESD filter (Z301) that all lines come through. If not, change Z301. If the keyboard still does not operate normally, try to use the Keyboard test in Phoenix to see if the pressed key is identified. If it is not identified, change the UPP (D400).

Receiver Troubleshooting

General instructions for RX troubleshooting

Start the Phoenix software and use it to start the required RX mode of the mobile phone. The troubleshooting flowchart is divided into three steps: (1) general checking, (2) local checking, and (3) RX chain checking.

Note: Before changing ASICs or filters, all solderings and missing components must be checked visually. After any possible component changes, the phone must be tuned with the Phoenix autotune SW.

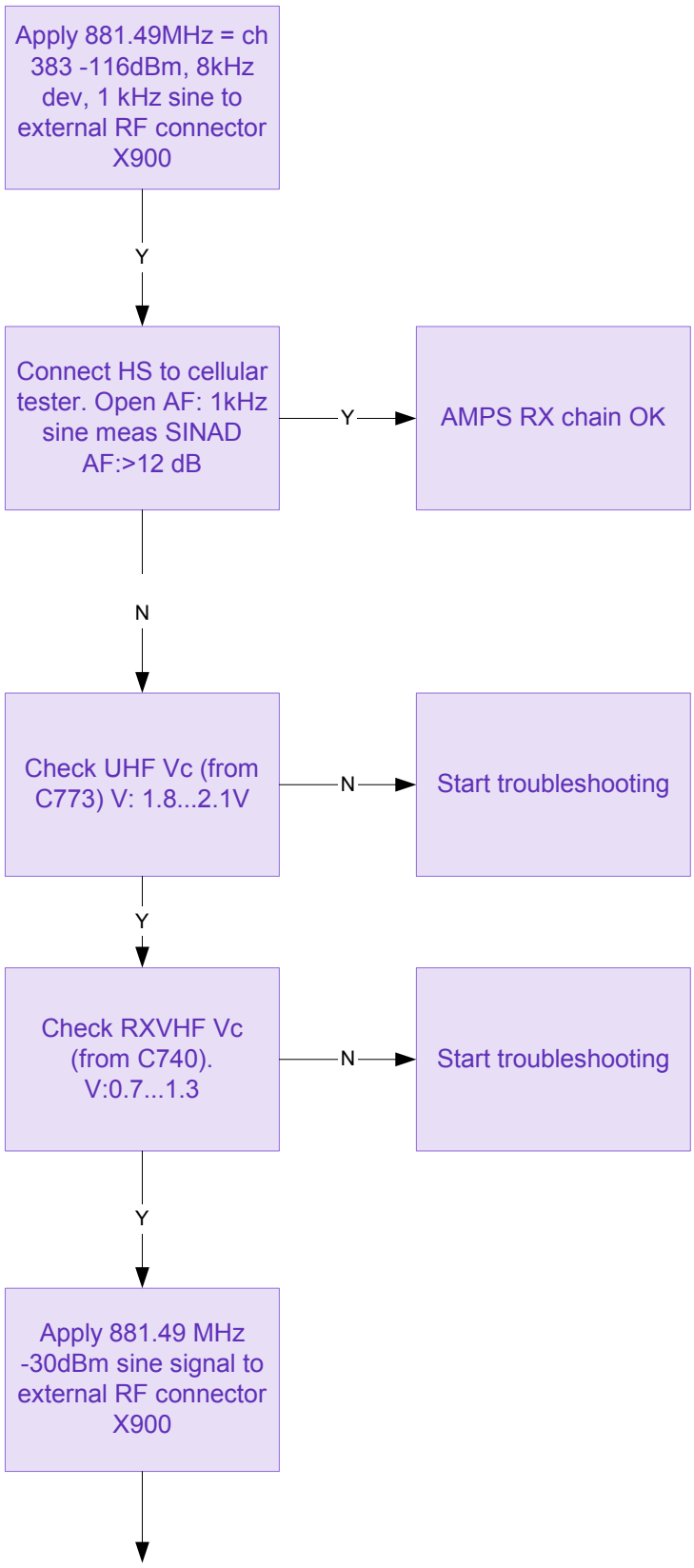
Path of the received signal

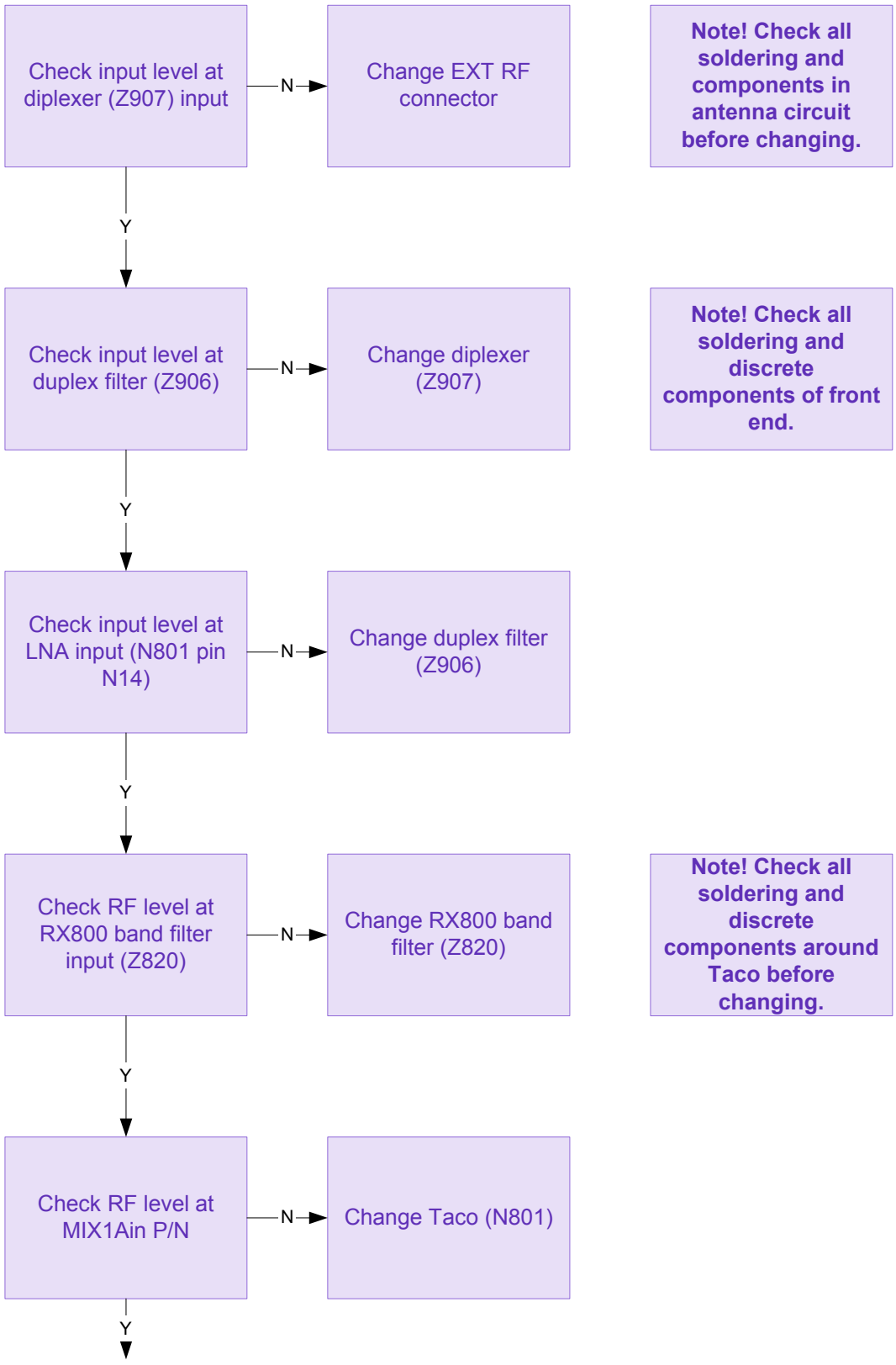
Block level description of the receiver:

(Antenna/ext RF) – Diplexer – Duplexer – Low Noise Amplifier (LNA) – RX band filter – First mixer – 135.54 MHz RX IF filter – IF-amplifier – second mixer – 14 kHz low-pass filter – adjustable IQ amplifier – Baseband.

Fault-finding charts for receiver chain

AMPS


Apply 881.49MHz = ch 383 -116dBm, 8kHz dev, 1 kHz sine to external RF connector X900
Y
Connect HS to cellular tester. Open AF: 1kHz sine meas SINAD AF:>12 dB
Y
AMPS RX chain OK
N
Check UHF Vc (from C773) V: 1.8...2.1V
N
Start troubleshooting
Y
Check RXVHF Vc (from C740). V:0.7...1.3
N
Start troubleshooting
Y
Apply 881.49 MHz -30dBm sine signal to external RF connector X900


Check input level at diplexer (Z907) input
N
Change EXT RF connector
Note! Check all soldering and components in antenna circuit before changing.
Y
Check input level at duplex filter (Z906)
N
Change diplexer (Z907)
Note! Check all soldering and discrete components of front end.
Y
Check input level at LNA input (N801 pin N14)
N
Change duplex filter (Z906)
Y
Check RF level at RX800 band filter input (Z820)
N
Change RX800 band filter (Z820)
Note! Check all soldering and discrete components around Taco before changing.
Y
Check RF level at MIX1Ain P/N
N
Change Taco (N801)
Y

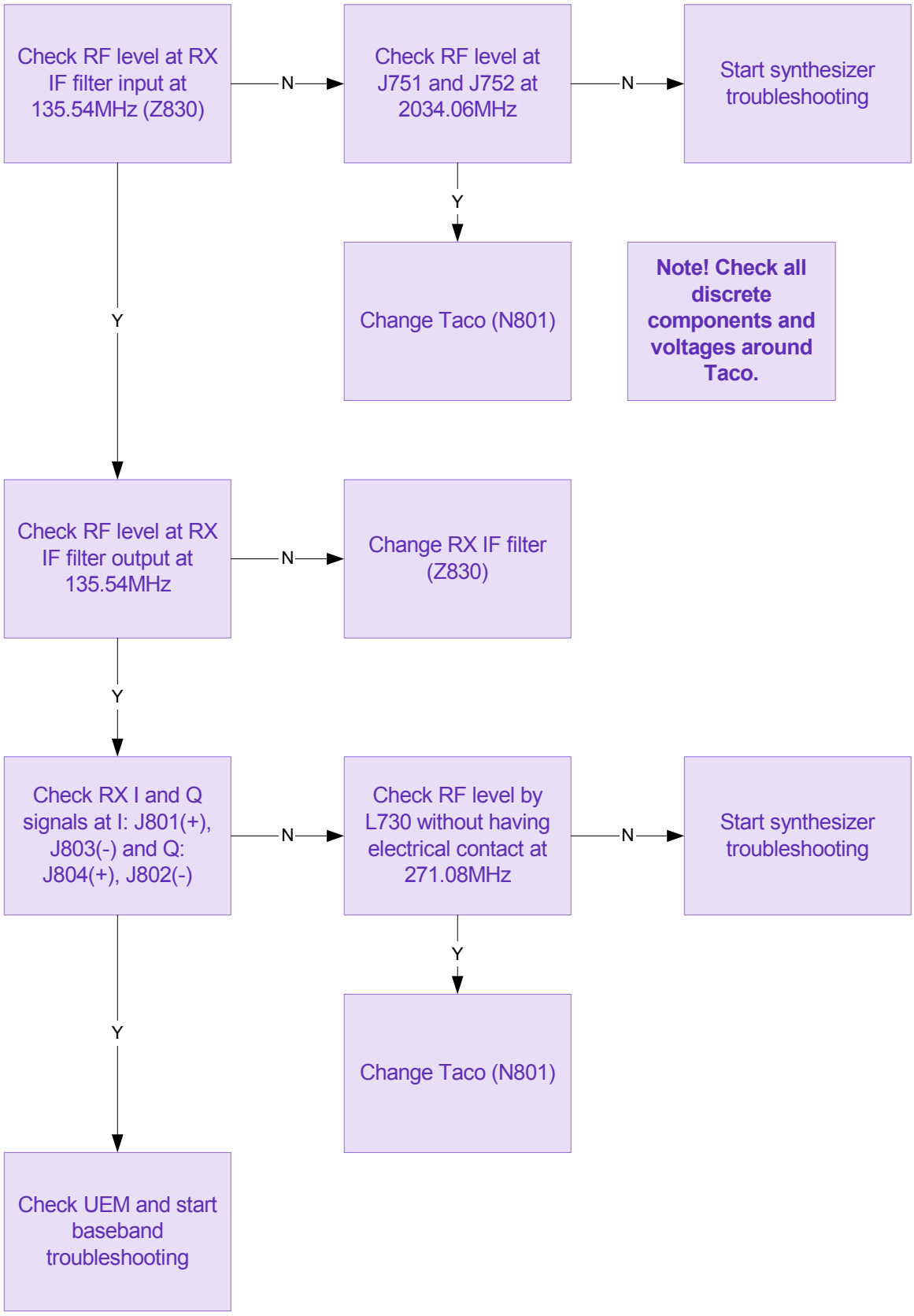

Check RF level at RX IF filter input at 135.54MHz (Z830)
N
Check RF level at J751 and J752 at 2034.06MHz
N
Start synthesizer troubleshooting
Y
Change Taco (N801)
Note! Check all discrete components and voltages around Taco.
Y
Check RF level at RX IF filter output at 135.54MHz
N
Change RX IF filter (Z830)
Y
Check RX I and Q signals at I: J801(+), J803(-) and Q: J804(+), J802(-)
N
Check RF level by L730 without having electrical contact at 271.08MHz
N
Start synthesizer troubleshooting
Y
Change Taco (N801)
Y
Check UEM and start baseband troubleshooting

Figure 10: Fault tree. AMPS

TDMA800

Since the same physical signal path is used for both analog and digital modes at the lower band, there is no need for additional troubleshooting in the digital mode. So if the digital mode at the lower band is not working properly, start the analog mode troubleshooting.

Transmitter Troubleshooting

General instructions for TX troubleshooting

Always use an RF cable connected from an external RF connector to the analyzer via (rf-power) attenuator. This is important to protect the analyzer against excessive RF power and not to allow leakage of undesired RF power into the cellular frequencies.

1 Start the Phoenix software and select the TX mode under *Testing* (AMPS, DAMPS).

2 It is useful to select the mid channel (383 for AMPS/DAMPS) and the power level 2.

Note: After any component change, tune the phone with the Phoenix autotune SW.

Path of the transmitted signal

AMPS/DAMPS

UEM TX I/Q DA-converters -> I/Q modulator and Digital gain step amplifier (Taco) -> IF-BPF -> Upconverter+driver (Taco) -> Balun->BPF -> PA -> Coupler (Power detector) > Duplex-filter -> Diplexer -> EXT RF Connector Switch -> Antenna

Fault-finding charts for the transmitter

AMPS

1 Start the Phoenix software and set the phone to the analog mode by using RF Test UI.

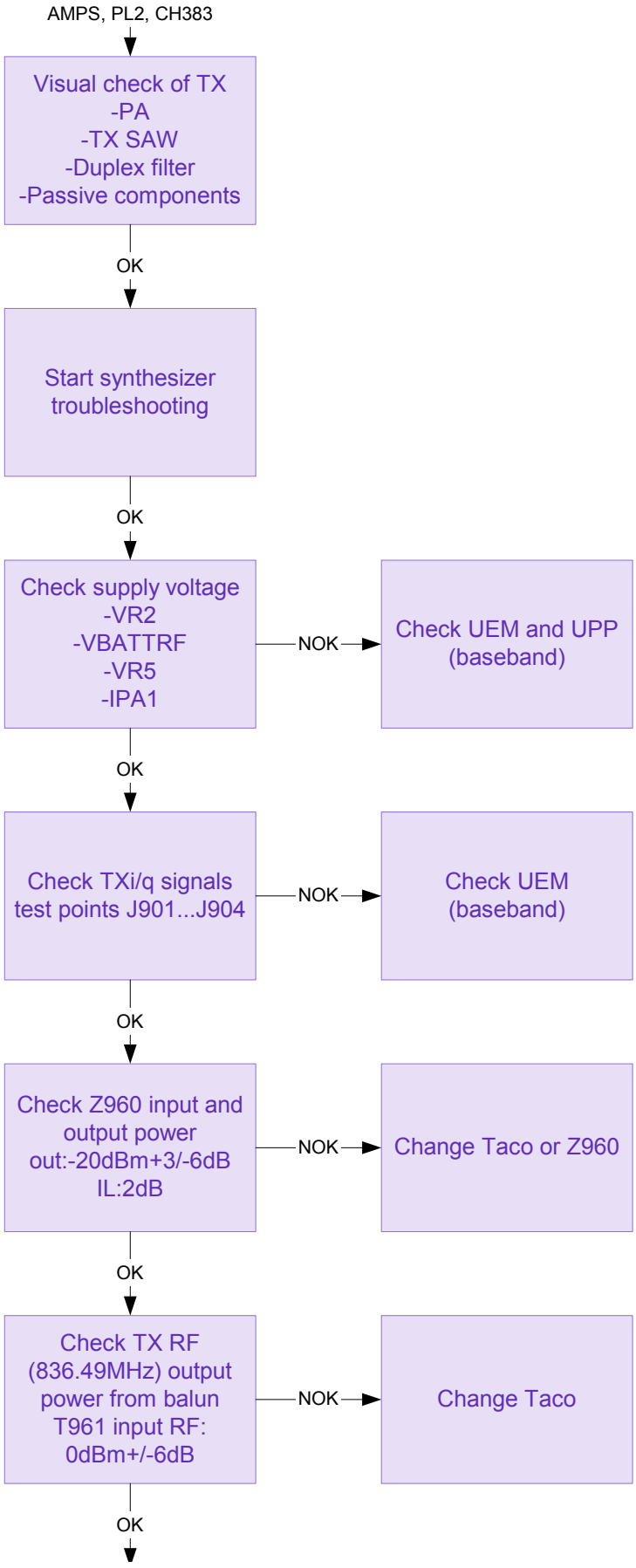
2 Set the channel to 383 and the power level to 2.

3 Connect the RF cable to the Ext RF connector switch.

4 Connect the cable to the Spectrum analyzer input.

5 Measure the RF level.

Note: Insertion loss of the cable and attenuations.


AMPS, PL2, CH383
Visual check of TX
-PA
-TX SAW
-Duplex filter
-Passive components
OK
Start synthesizer troubleshooting
OK
Check supply voltage
-VR2
-VBATTRF
-VR5
-IPA1
NOK
Check UEM and UPP (baseband)
OK
Check TXi/q signals test points J901...J904
NOK
Check UEM (baseband)
OK
Check Z960 input and output power
out:-20dBm+3/-6dB
IL:2dB
NOK
Change Taco or Z960
OK
Check TX RF (836.49MHz) output power from balun T961 input RF:
0dBm+/-6dB
NOK
Change Taco
OK

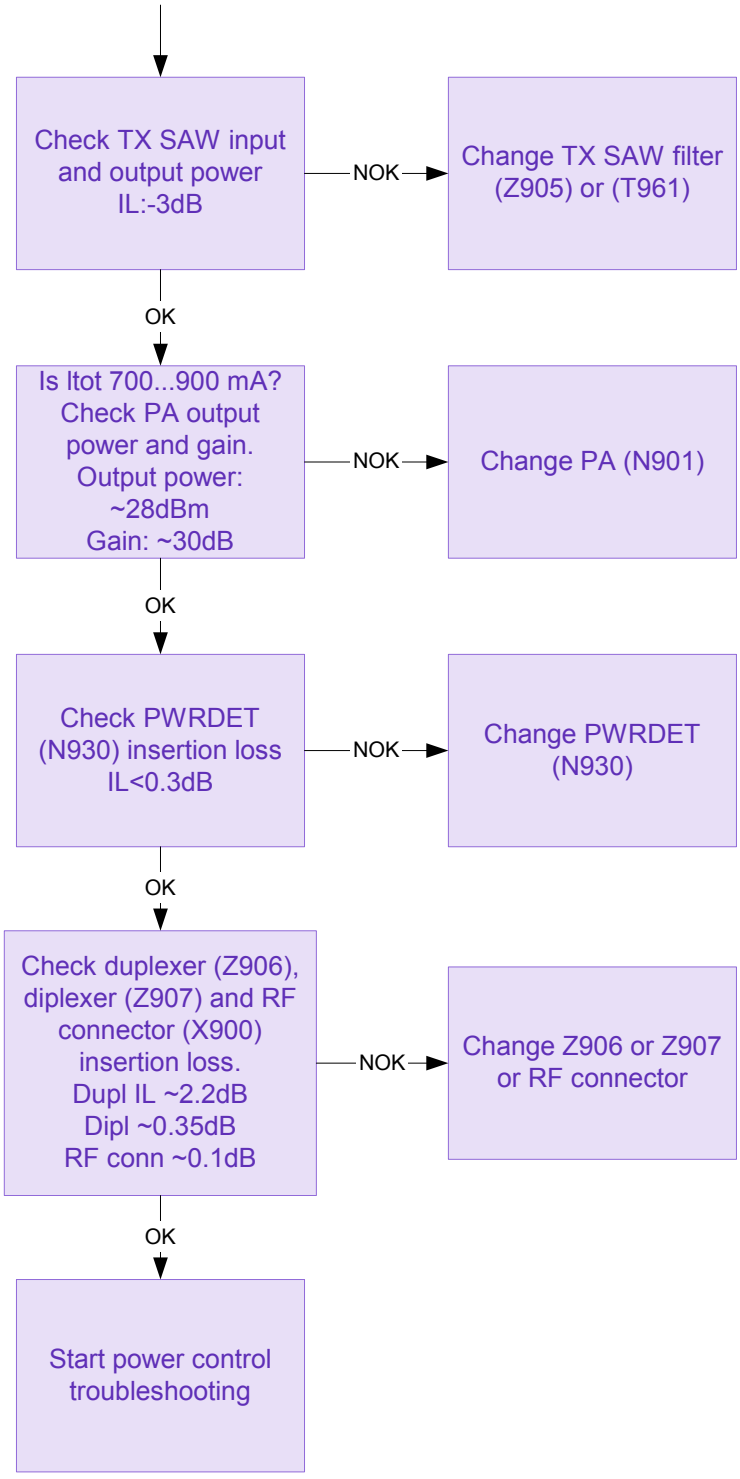

Check TX SAW input and output power IL:-3dB
NOK
Change TX SAW filter (Z905) or (T961)
OK
Is Itot 700...900 mA? Check PA output power and gain. Output power: ~28dBm Gain: ~30dB
NOK
Change PA (N901)
OK
Check PWRDET (N930) insertion loss IL<0.3dB
NOK
Change PWRDET (N930)
OK
Check duplexer (Z906), diplexer (Z907) and RF connector (X900) insertion loss. Dupl IL ~2.2dB Dipl ~0.35dB RF conn ~0.1dB
NOK
Change Z906 or Z907 or RF connector
OK
Start power control troubleshooting

Figure 11: Fault tree. Transmitter troubleshooting

TDMA800

The transmitter chain is exactly the same as the AMPS mode, except for the IPA current.

Power control loop

Basically, the power detection is done with the Power detector module and power control is done inside the Taco.

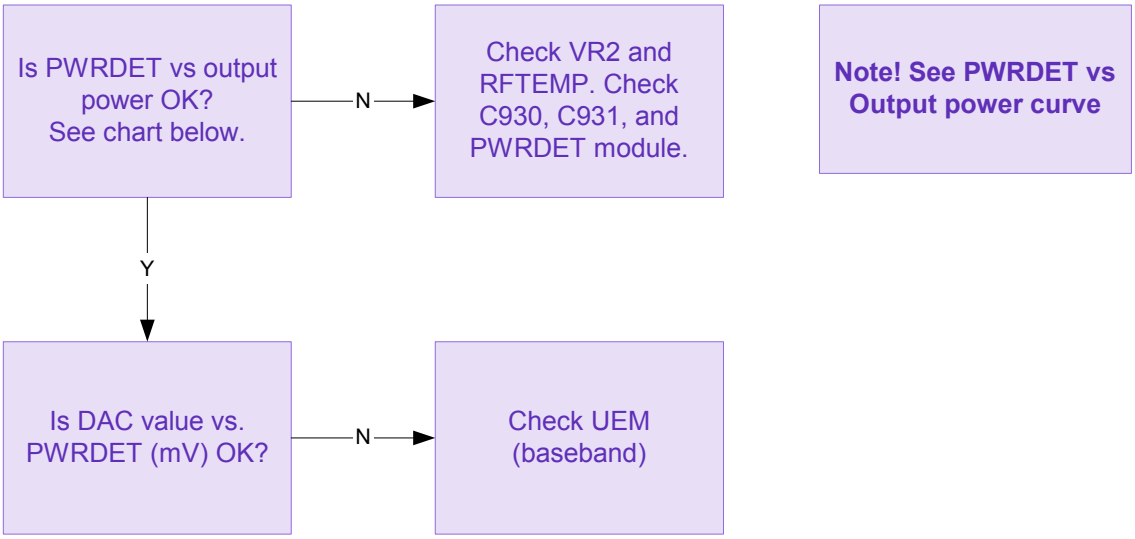

Is PWRDET vs output power OK? See chart below.
N
Check VR2 and RFTEMP. Check C930, C931, and PWRDET module.
Note! See PWRDET vs Output power curve
Y
Is DAC value vs. PWRDET (mV) OK?
N
Check UEM (baseband)

Figure 12: Fault tree: Power control loop

The detected voltages are illustrated in the following table and diagram:

800A				800D		
	Pout	TXPWRDET		Pout	TXPWRDET	
PL	dBm	dac	mV	dBm	dac	mV
2	24.8	712	1984	27.3	779	2201
3	21.6	512	1437	23.3	476	1312
4	18.5	340	961	19.3	284	759
5	14.5	239	686	15.3	171	462
6	10.5	180	510	11.3	98	271
7	6.5	141	415	7.3	56	151
8	-	-	-	3.3	30	84
9	-	-	-	-0.7	14	46
§0	-	-	-	-4.7	5	16

Note: DAC values may vary about +- 20%

Note: TXPWRDET is the difference between TX on burst and off burst.

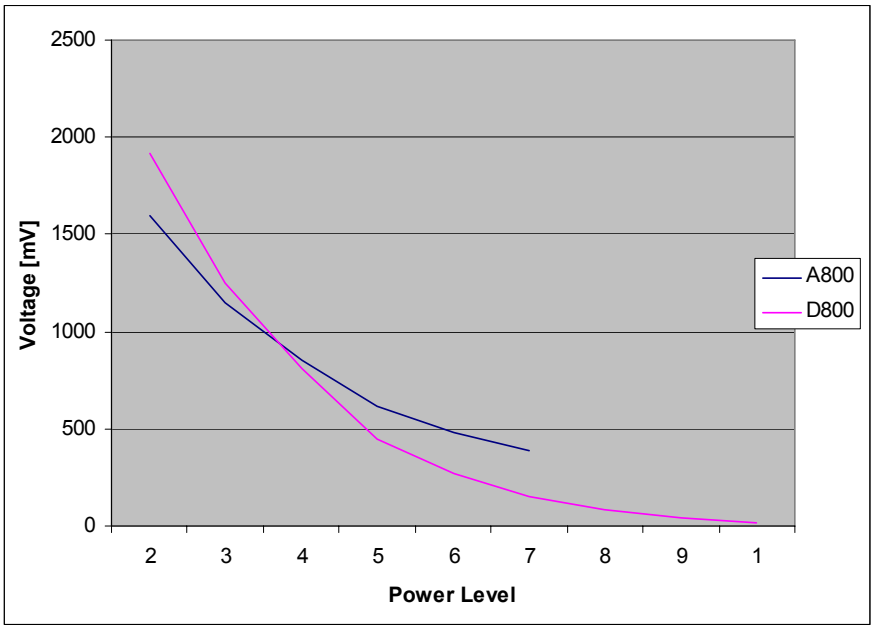


Figure 13: Detected voltage limits

Synthesizer Troubleshooting

There are four oscillators generating the needed frequencies for RF section: 19.44 MHz VCTCXO is used as a reference signal oscillator reference oscillator, 2 GHz UHF VCO with loop filter circuit is used for RX and TX channel selection, TX VHF and RF VHF are for TX modulator, and 2nd RX mixer locals generation.

The VHF synthesizers are integrated in Taco, but have external VCO coils and loop filters. RX VHF frequency is fixed 271.08 MHz and TX VHF is fixed to 271.08 MHz . All locals are locked to stable 19.44 MHz reference oscillator.

The frequency range for 2 GHz UHF VCO is: 2009.1 MHz ... 2125.53 MHz. The output frequency range for the lower band is from 2009.16 MHz to 2059.02 MHz.

A practical way to check out synthesizer status is by measuring control voltage of the VCO from the Integrator capacitor. If voltage is stable and reasonable, local oscillators are running correctly.

19.44 MHz reference oscillator

The VCTCXO oscillator frequency (G790) is controlled by UEM. This output 19.44 MHz signal is connected to Taco. It is used as a reference signal in Taco and also fed out as buffered clock signal to UPP. All synthesizers use divided 19.44 MHz signal as a reference signal for Phase locked loop to provide correct LO frequency.

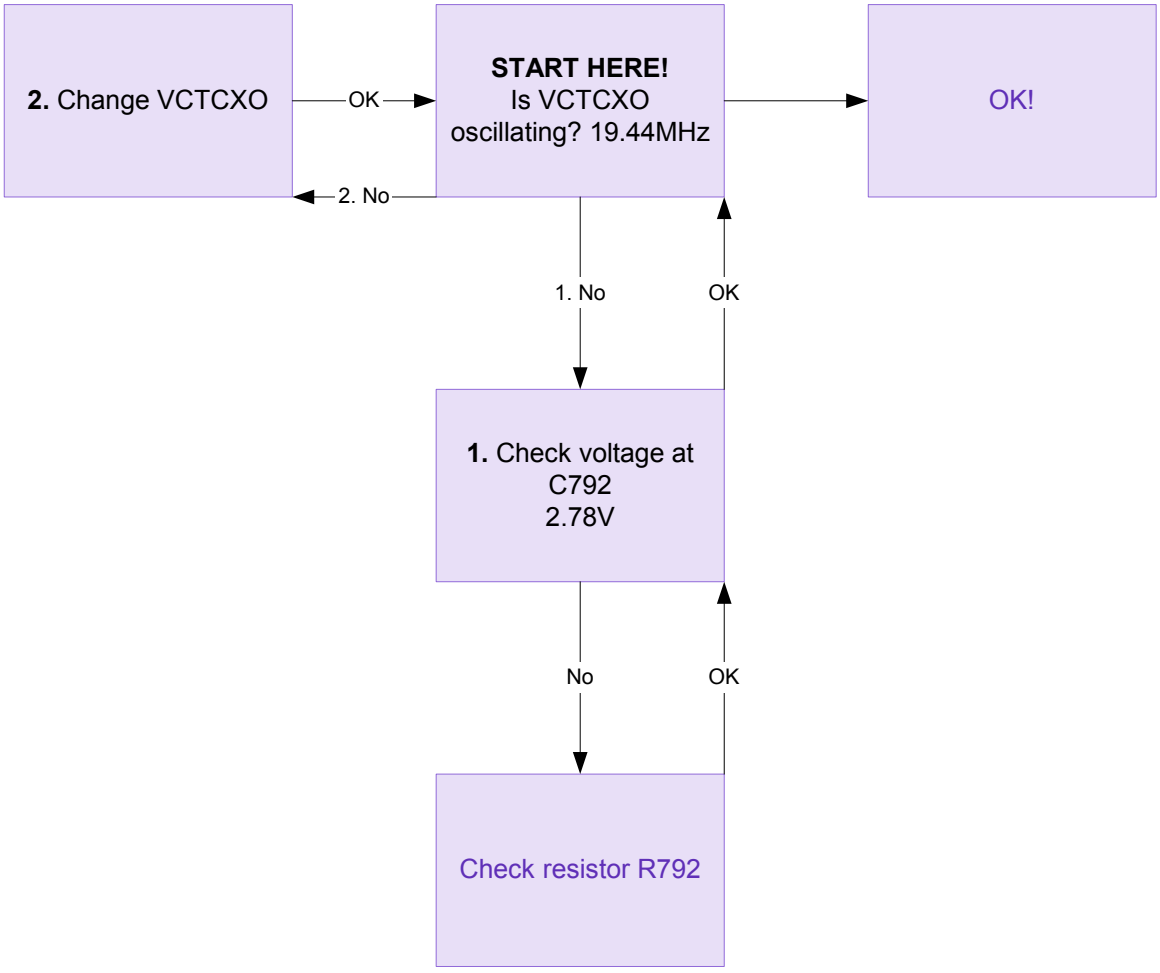


Figure 14: Fault tree: 19.44 MHz oscillator

RX VHF

The RX VHF signal is used to generate receiver Intermediate frequency. RX VHF has one fixed frequency 271.08 MHz. Operating frequency is locked in Phase locked Loop.

RX VHF PLL output signal is integrated in Taco. There are only four external components: VCO coil (L730), and loop filter components C740, C741, and R741.

Fault-finding chart for RX VHF VCO

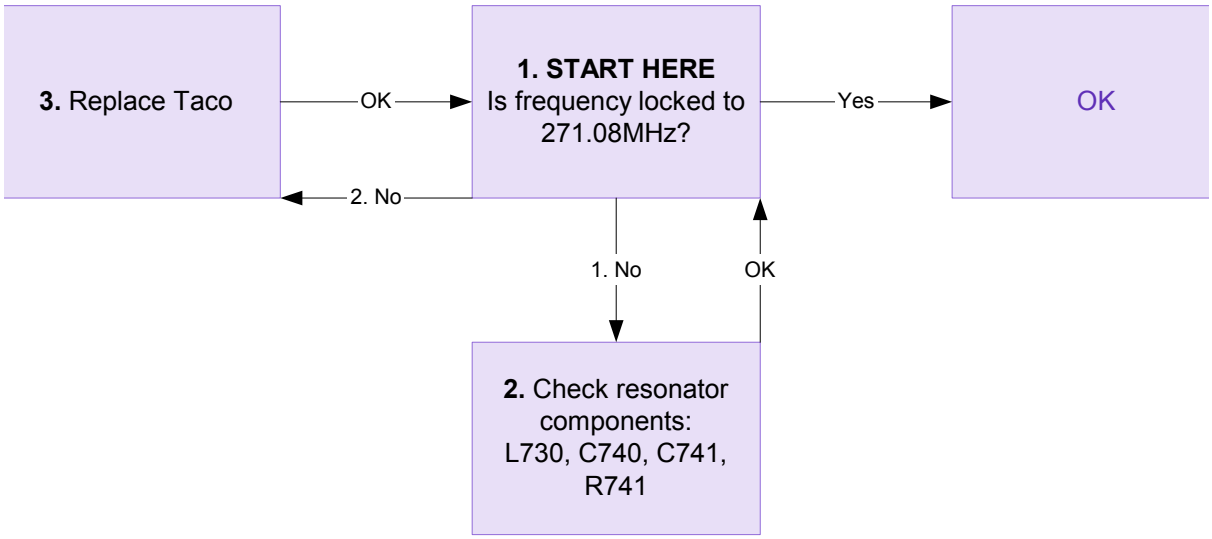


Figure 15: Fault tree: RX VHF

TX VHF

The TX VHF signal is used to generate transmitter Intermediate frequency. TX VHF VCO has one fixed frequency (361.08). Operating frequency is locked in Phase locked loop. TX VHF VCO output signal is divided by 2 and fed to the modulator.

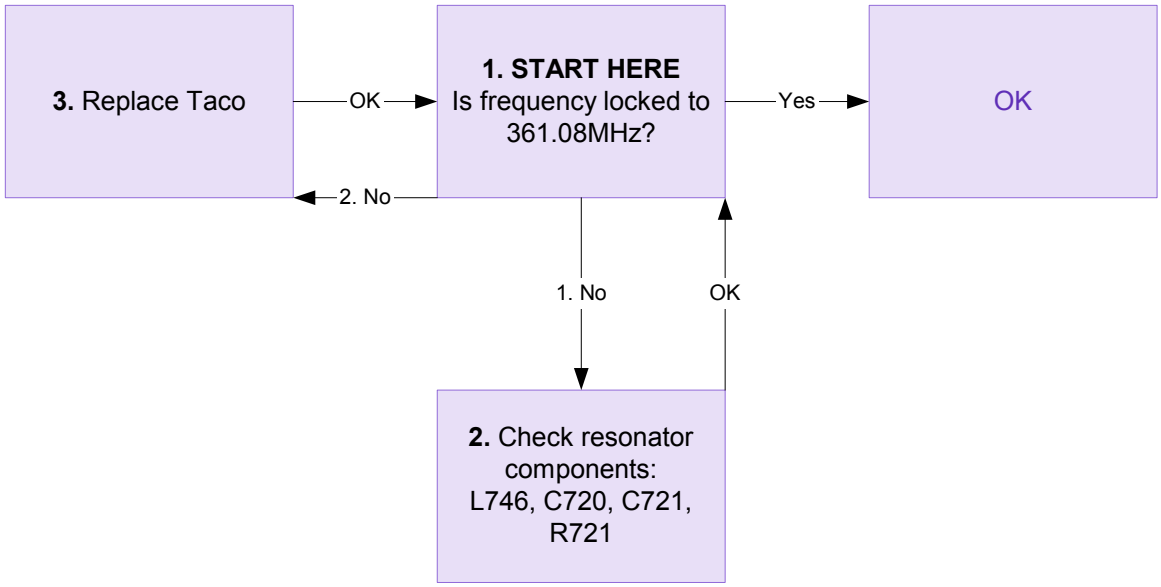


Figure 16: Fault tree: TX VHF

UHF Synthesizer

The UHF VCO signal is used for RF channel selection. This signal is fed as a local signal for 1st mixer of RX path and for upconverter of TX path. When operating on lower band the VCO signal is divided by 2 before feeding. This synthesizer is used for channel selection in all modes.

The UHF synthesizer consists of an external 2GHz VCO module with loop filter components and integrated PLL parts in Taco. Integrated charge pump circuit allows analog and digital operation modes. The VCO Oscillation frequency is from 2009.1 MHz to 2125.53 MHz. The output frequency of the VCO module depends on the DC control voltage which is controlled by PLL circuit inside Taco.

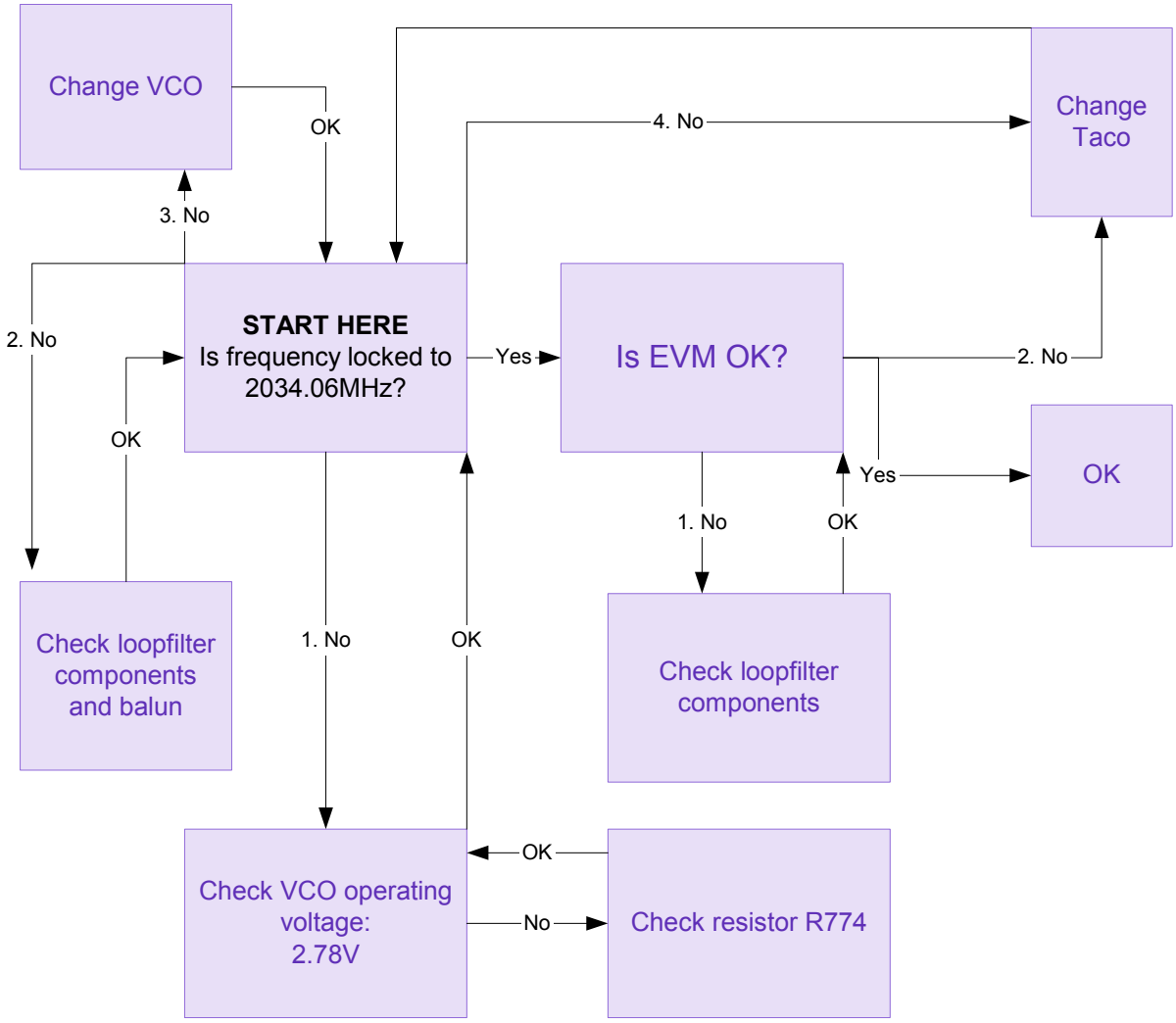


Figure 17: Fault tree: UHF Synthesizer